

# Full SAP Calculation Printout



|                                    |                                                            |               |       |                |            |
|------------------------------------|------------------------------------------------------------|---------------|-------|----------------|------------|
| Property Reference                 | UNIT 40                                                    |               |       | Issued on Date | 02/07/2025 |
| Assessment Reference               | UNIT 40                                                    | Prop Type Ref |       |                |            |
| Property                           | Flat 41, Alexander House, 205 Kings Road, READING, RG1 4FW |               |       |                |            |
|                                    |                                                            |               |       |                |            |
| SAP Rating                         | 85 B                                                       | DER           | 3.86  | TER            | 10.10      |
| Environmental                      | 97 A                                                       | % DER < TER   |       |                | 61.78      |
| CO <sub>2</sub> Emissions (t/year) | 0.24                                                       | DFEE          | 41.30 | TFEE           | 41.87      |
| Compliance Check                   | See BREL                                                   | % DFEE < TFEE |       |                | 1.36       |
| % DPER < TPER                      | 24.96                                                      | DPER          | 40.53 | TPER           | 54.01      |
|                                    |                                                            |               |       |                |            |
| Assessor Details                   | Mr. Ondrej Gajdos                                          |               |       | Assessor ID    | W452-0001  |
| Client                             |                                                            |               |       |                |            |

SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
CALCULATION OF FABRIC ENERGY EFFICIENCY

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|----------------------|-----------------------------|
| Main dwelling                                          |                           |                      |                             |
| Ground floor                                           | 67.8000 (1b)              | 2.5000 (2b)          | 169.5000 (1b) - (3b)        |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.8000                   |                      | 169.5000 (4)                |
| Dwelling volume                                        |                           |                      | 169.5000 (5)                |

## 2. Ventilation rate

|                                                    | m <sup>3</sup> per hour |
|----------------------------------------------------|-------------------------|
| Number of open chimneys                            | 0 * 80 = 0.0000 (6a)    |
| Number of open flues                               | 0 * 20 = 0.0000 (6b)    |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 (6c)    |
| Number of flues attached to solid fuel boiler      | 0 * 20 = 0.0000 (6d)    |
| Number of flues attached to other heater           | 0 * 35 = 0.0000 (6e)    |
| Number of blocked chimneys                         | 0 * 20 = 0.0000 (6f)    |
| Number of intermittent extract fans                | 2 * 10 = 20.0000 (7a)   |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c)    |

|                                                                                                    |                            |
|----------------------------------------------------------------------------------------------------|----------------------------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = 0.1180 (8) |
| Pressure test                                                                                      | Yes                        |
| Pressure Test Method                                                                               | Blower Door                |
| Measured/design AP50                                                                               | 3.1300 (17)                |
| Infiltration rate                                                                                  | 0.2745 (18)                |
| Number of sides sheltered                                                                          | 3 (19)                     |

|                                                      |                                         |
|------------------------------------------------------|-----------------------------------------|
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = 0.2127 (21)        |

|                                                                                                         | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|---------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                                                                              | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor                                                                                             | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate                                                                                         | 0.2712 | 0.2659 | 0.2606 | 0.2340 | 0.2287 | 0.2021 | 0.2021 | 0.1968 | 0.2127 | 0.2287 | 0.2393 | 0.2500 (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23c) |
| Effective ac                                                                                            | 0.5368 | 0.5354 | 0.5340 | 0.5274 | 0.5261 | 0.5204 | 0.5204 | 0.5194 | 0.5226 | 0.5261 | 0.5286 | 0.5312 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                                                  | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|--------------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Main dwelling                                                            |                         |                            |                           |                               |              |                                |                 |
| 1                                                                        |                         |                            | 6.5000                    | 1.1450                        | 7.4427       |                                | (27)            |
| 2                                                                        |                         |                            | 6.5000                    | 1.1450                        | 7.4427       |                                | (27)            |
| 3                                                                        |                         |                            | 6.5000                    | 1.1450                        | 7.4427       |                                | (27)            |
| 1                                                                        |                         |                            | 2.1000                    | 1.0000                        | 2.1000       |                                | (26)            |
| top floor exposed new                                                    | 33.0000                 | 19.5000                    | 13.5000                   | 0.2000                        | 2.7000       | 18.0000                        | 243.0000 (29a)  |
| corridor new                                                             | 52.5000                 | 2.1000                     | 50.4000                   | 0.2300                        | 11.5920      | 14.0000                        | 705.6000 (29a)  |
| flat roof new                                                            | 31.3000                 |                            | 31.3000                   | 0.1300                        | 4.0690       | 9.0000                         | 281.7000 (30)   |
| roof terrace new                                                         | 36.5000                 |                            | 36.5000                   | 0.1300                        | 4.7450       | 9.0000                         | 328.5000 (30)   |
| Total net area of external elements A <sub>um</sub> (A, m <sup>2</sup> ) |                         |                            | 153.3000                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                                      |                         |                            |                           | (26)...(30) + (32) =          | 47.5342      |                                | (33)            |
| Main dwelling                                                            |                         |                            |                           |                               |              |                                |                 |
| pw                                                                       |                         |                            | 10.7500                   | 0.0000                        | 0.0000       | 20.0000                        | 215.0000 (32)   |
| pf                                                                       |                         |                            | 67.8000                   |                               |              | 30.0000                        | 2034.0000 (32d) |
| iw                                                                       |                         |                            | 88.0000                   |                               |              | 9.0000                         | 792.0000 (32c)  |

|                                                                |                                      |                |
|----------------------------------------------------------------|--------------------------------------|----------------|
| Heat capacity Cm = Sum(A x k)                                  | (28)...(30) + (32) + (32a)...(32e) = | 4599.8000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                                      | 67.8437 (35)   |
| List of Thermal Bridges                                        |                                      |                |



elmhurst  
energy

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## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                     |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                     |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                     |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                 | Oct     | Nov     | Dec          |
| tau                                                                         | 15.3062 | 15.3209 | 15.3353 | 15.4033 | 15.4161 | 15.4759 | 15.4759 | 15.4870 | 15.4528             | 15.4161 | 15.3902 | 15.3633      |
| alpha                                                                       | 2.0204  | 2.0214  | 2.0224  | 2.0269  | 2.0277  | 2.0317  | 2.0317  | 2.0325  | 2.0302              | 2.0277  | 2.0260  | 2.0242       |
| util living area                                                            | 0.9145  | 0.8745  | 0.8107  | 0.6989  | 0.5667  | 0.4325  | 0.3323  | 0.3784  | 0.5672              | 0.7762  | 0.8835  | 0.9228 (86)  |
| MIT                                                                         | 17.6361 | 18.1205 | 18.8352 | 19.6919 | 20.3390 | 20.7308 | 20.8877 | 20.8500 | 20.5103             | 19.5977 | 18.4582 | 17.5378 (87) |
| Th 2                                                                        | 19.8951 | 19.8960 | 19.8970 | 19.9013 | 19.9021 | 19.9058 | 19.9058 | 19.9065 | 19.9044             | 19.9021 | 19.9004 | 19.8987 (88) |
| util rest of house                                                          | 0.9047  | 0.8607  | 0.7902  | 0.6676  | 0.5224  | 0.3729  | 0.2585  | 0.3008  | 0.5063              | 0.7439  | 0.8683  | 0.9139 (89)  |
| MIT 2                                                                       | 16.8457 | 17.3174 | 18.0082 | 18.8185 | 19.4040 | 19.7374 | 19.8534 | 19.8325 | 19.5737             | 18.7575 | 17.6604 | 16.7518 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / | (4) =   |         | 0.4705 (91)  |
| MIT                                                                         | 17.2176 | 17.6953 | 18.3973 | 19.2294 | 19.8439 | 20.2048 | 20.3400 | 20.3112 | 20.0144             | 19.1528 | 18.0358 | 17.1216 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                     |         |         | 0.0000       |
| adjusted MIT                                                                | 17.2176 | 17.6953 | 18.3973 | 19.2294 | 19.8439 | 20.2048 | 20.3400 | 20.3112 | 20.0144             | 19.1528 | 18.0358 | 17.1216 (93) |

## 8. Space heating requirement

|                                                                                |           |           |          |          |          |          |          |          |          |               |          |                |
|--------------------------------------------------------------------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
|                                                                                | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
| Utilisation                                                                    | 0.8729    | 0.8259    | 0.7570   | 0.6462   | 0.5199   | 0.3898   | 0.2886   | 0.3306   | 0.5129   | 0.7181        | 0.8350   | 0.8834 (94)    |
| Useful gains                                                                   | 439.3218  | 513.5299  | 567.5498 | 593.3671 | 539.4796 | 409.3099 | 288.6059 | 295.4421 | 393.6105 | 438.6609      | 425.7055 | 419.2449 (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000       | 7.1000   | 4.2000 (96)    |
| Heat loss rate W                                                               | 1078.3231 | 1067.0915 | 991.2725 | 856.8400 | 674.9893 | 462.7412 | 308.7857 | 322.6882 | 489.0313 | 708.8759      | 907.9063 | 1074.6537 (97) |
| Space heating kWh                                                              | 475.4170  | 371.9934  | 315.2497 | 189.7005 | 100.8192 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 201.0400      | 347.1846 | 487.6241 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |          |          |          |          |          |          |          |               |          | 2489.0284      |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |           |           |          |          |          |          |          |          |          |               |          | 0.0000         |
| Space heating kWh                                                              | 475.4170  | 371.9934  | 315.2497 | 189.7005 | 100.8192 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 201.0400      | 347.1846 | 487.6241 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |          |          |          |          |          |          |          |               |          | 2489.0284      |
| Space heating per m2                                                           |           |           |          |          |          |          |          |          |          | (98c) / (4) = |          | 36.7113 (99)   |

## 8c. Space cooling requirement

|                                                     |        |        |        |        |         |           |           |           |                    |         |        |                |
|-----------------------------------------------------|--------|--------|--------|--------|---------|-----------|-----------|-----------|--------------------|---------|--------|----------------|
| Calculated for June, July and August. See Table 10b |        |        |        |        |         |           |           |           |                    |         |        |                |
|                                                     | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul       | Aug       | Sep                | Oct     | Nov    | Dec            |
| Ext. temp.                                          | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000   | 16.6000   | 16.4000   | 14.1000            | 10.6000 | 7.1000 | 4.2000         |
| Heat loss rate W                                    | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 776.0839  | 610.9597  | 627.0212  | 0.0000             | 0.0000  | 0.0000 | 0.0000 (100)   |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7993    | 0.8450    | 0.8123    | 0.0000             | 0.0000  | 0.0000 | 0.0000 (101)   |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 620.3181  | 516.2757  | 509.3109  | 0.0000             | 0.0000  | 0.0000 | 0.0000 (102)   |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1191.0334 | 1134.4256 | 1012.0917 | 0.0000             | 0.0000  | 0.0000 | 0.0000 (103)   |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 410.9150  | 459.9035  | 374.0689  | 0.0000             | 0.0000  | 0.0000 | 0.0000 (104)   |
| Cooled fraction                                     |        |        |        |        |         |           |           |           | fC = cooled area / | (4) =   |        | 1.0000 (105)   |
| Intermittency factor (Table 10b)                    | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500  | 0.2500    | 0.2500    | 0.2500    | 0.2500             | 0.2500  | 0.2500 | 0.2500 (106)   |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 102.7288  | 114.9759  | 93.5172   | 0.0000             | 0.0000  | 0.0000 | 0.0000 (107)   |
| Space cooling requirement                           |        |        |        |        |         |           |           |           |                    |         |        | 311.2219 (107) |
| Energy for space heating                            |        |        |        |        |         |           |           |           |                    |         |        | 36.7113 (99)   |
| Energy for space cooling                            |        |        |        |        |         |           |           |           |                    |         |        | 4.5903 (108)   |
| Total                                               |        |        |        |        |         |           |           |           |                    |         |        | 41.3016 (109)  |
| Fabric Energy Efficiency (DFEE)                     |        |        |        |        |         |           |           |           |                    |         |        | 41.3 (109)     |

## SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

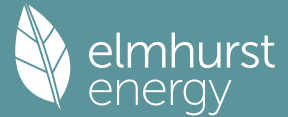
## 1. Overall dwelling characteristics

|                                                        |              |                                   |                        |
|--------------------------------------------------------|--------------|-----------------------------------|------------------------|
| Main dwelling                                          | Area (m2)    | Storey height (m)                 | Volume (m3)            |
| Ground floor                                           | 67.8000 (1b) | x 2.5000 (2b)                     | = 169.5000 (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.8000      |                                   | (4)                    |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 169.5000 (5)           |

## 2. Ventilation rate

|                                                                                                    |                 |              |
|----------------------------------------------------------------------------------------------------|-----------------|--------------|
| m3 per hour                                                                                        |                 |              |
| Number of open chimneys                                                                            | 0 * 80 =        | 0.0000 (6a)  |
| Number of open flues                                                                               | 0 * 20 =        | 0.0000 (6b)  |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 =        | 0.0000 (6c)  |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 =        | 0.0000 (6d)  |
| Number of flues attached to other heater                                                           | 0 * 35 =        | 0.0000 (6e)  |
| Number of blocked chimneys                                                                         | 0 * 20 =        | 0.0000 (6f)  |
| Number of intermittent extract fans                                                                | 2 * 10 =        | 20.0000 (7a) |
| Number of passive vents                                                                            | 0 * 10 =        | 0.0000 (7b)  |
| Number of flueless gas fires                                                                       | 0 * 40 =        | 0.0000 (7c)  |
| Air changes per hour                                                                               |                 |              |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1180 (8)   |

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|                                                      |  |  |  |  |  |  |  |  |  |  |  |                                         |
|------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|-----------------------------------------|
| Pressure test                                        |  |  |  |  |  |  |  |  |  |  |  | Yes                                     |
| Pressure Test Method                                 |  |  |  |  |  |  |  |  |  |  |  | Blower Door                             |
| Measured/design AP50                                 |  |  |  |  |  |  |  |  |  |  |  | 5.0000 (17)                             |
| Infiltration rate                                    |  |  |  |  |  |  |  |  |  |  |  | 0.3680 (18)                             |
| Number of sides sheltered                            |  |  |  |  |  |  |  |  |  |  |  | 3 (19)                                  |
| Shelter factor                                       |  |  |  |  |  |  |  |  |  |  |  | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor |  |  |  |  |  |  |  |  |  |  |  | (21) = (18) x (20) = 0.2852 (21)        |

|                                                                                                         |        |        |        |        |        |        |        |        |        |        |        |              |
|---------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
| Wind factor                                                                                             | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Adj infilt rate                                                                                         | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
|                                                                                                         | 0.3636 | 0.3565 | 0.3494 | 0.3137 | 0.3066 | 0.2709 | 0.2709 | 0.2638 | 0.2852 | 0.3066 | 0.3208 | 0.3351 (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23c) |
| Effective ac                                                                                            | 0.5661 | 0.5635 | 0.5610 | 0.5492 | 0.5470 | 0.5367 | 0.5367 | 0.5348 | 0.5407 | 0.5470 | 0.5515 | 0.5561 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                         | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K |
|-------------------------------------------------|-------------|----------------|---------------|------------------|------------------------------|-------------------|---------------|
| Main dwelling                                   |             |                |               |                  |                              |                   |               |
| TER Opaque door                                 |             |                | 2.1000        | 1.0000           | 2.1000                       |                   | (26)          |
| TER Opening Type                                |             |                | 14.8500       | 1.1450           | 17.0038                      |                   | (27)          |
| top floor exposed new                           | 33.0000     | 14.8500        | 18.1500       | 0.1800           | 3.2670                       |                   | (29a)         |
| corridor new                                    | 52.5000     | 2.1000         | 50.4000       | 0.1800           | 9.0720                       |                   | (29a)         |
| flat roof new                                   | 31.3000     |                | 31.3000       | 0.1100           | 3.4430                       |                   | (30)          |
| roof terrace new                                | 36.5000     |                | 36.5000       | 0.1100           | 4.0150                       |                   | (30)          |
| Total net area of external elements Aum (A, m2) |             |                | 153.3000      |                  |                              |                   | (31)          |
| Fabric heat loss, W/K = Sum (A x U)             |             |                |               |                  | (26)...(30) + (32) = 38.9008 |                   | (33)          |
| Main dwelling                                   |             |                |               |                  |                              |                   |               |
| pw                                              |             |                | 10.7500       | 0.0000           | 0.0000                       |                   | (32)          |

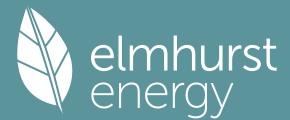
|                                                                  |  |  |  |  |  |  |  |         |           |                               |  |              |
|------------------------------------------------------------------|--|--|--|--|--|--|--|---------|-----------|-------------------------------|--|--------------|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                |  |  |  |  |  |  |  |         |           |                               |  | 67.8437 (35) |
| List of Thermal Bridges                                          |  |  |  |  |  |  |  |         |           |                               |  |              |
| K1 Element                                                       |  |  |  |  |  |  |  |         |           |                               |  |              |
| E2 Other lintels (including other steel lintels)                 |  |  |  |  |  |  |  | Length  | Psi-value | Total                         |  |              |
| E3 Sill                                                          |  |  |  |  |  |  |  | 8.8000  | 0.0500    | 0.4400                        |  |              |
| E4 Jamb                                                          |  |  |  |  |  |  |  | 7.8000  | 0.0500    | 0.3900                        |  |              |
| E15 Flat roof with parapet                                       |  |  |  |  |  |  |  | 19.2000 | 0.0500    | 0.9600                        |  |              |
| E17 Corner (inverted - internal area greater than external area) |  |  |  |  |  |  |  | 13.3000 | 0.5600    | 7.4480                        |  |              |
| E18 Party wall between dwellings                                 |  |  |  |  |  |  |  | 2.5000  | -0.0900   | -0.2250                       |  |              |
| E24 Eaves (insulation at ceiling level - inverted)               |  |  |  |  |  |  |  | 5.0000  | 0.0600    | 0.3000                        |  |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |  |  |  |  |  |  |  | 13.3000 | 0.2400    | 3.1920                        |  | 12.5050 (36) |
| Point Thermal bridges                                            |  |  |  |  |  |  |  |         |           | (36a) = 0.0000                |  |              |
| Total fabric heat loss                                           |  |  |  |  |  |  |  |         |           | (33) + (36) + (36a) = 51.4058 |  | (37)         |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 31.6654 | 31.5218 | 31.3811 | 30.7200 | 30.5963 | 30.0205 | 30.0205 | 29.9139 | 30.2423 | 30.5963 | 30.8465 | 31.1081 (38) |
| Average = Sum(39)m / 12 =                                           | 83.0713 | 82.9277 | 82.7869 | 82.1258 | 82.0021 | 81.4263 | 81.4263 | 81.3197 | 81.6481 | 82.0021 | 82.2523 | 82.5139 (39) |
|                                                                     |         |         |         |         |         |         |         |         |         |         |         | 82.1252      |
| HLP                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 1.2252  | 1.2231  | 1.2210  | 1.2113  | 1.2095  | 1.2010  | 1.2010  | 1.1994  | 1.2042  | 1.2095  | 1.2132  | 1.2170 (40)  |
| Days in mont                                                        | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31           |

## 4. Water heating energy requirements (kWh/year)

|                                                                 |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|-----------------------------------------------------------------|----------|---------|---------|---------|---------|---------|---------|---------|---------|----------------------------------------|---------|----------|--------------|
| Assumed occupancy                                               |          |         |         |         |         |         |         |         |         |                                        |         |          | 2.1916 (42)  |
| Hot water usage for mixer showers                               |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (42a)        |
| Hot water usage for baths                                       |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 26.3401  | 25.9489 | 25.3980 | 24.3823 | 23.6217 | 22.7784 | 22.3229 | 22.8699 | 23.4655 | 24.3679                                | 25.4045 | 26.2510  | (42b)        |
| Hot water usage for other uses                                  |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 37.0737  | 35.7255 | 34.3774 | 33.0293 | 31.6811 | 30.3330 | 30.3330 | 31.6811 | 33.0293 | 34.3774                                | 35.7255 | 37.0737  | (42c)        |
| Average daily hot water use (litres/day)                        |          |         |         |         |         |         |         |         |         |                                        |         |          | 58.1247 (43) |
| Daily hot water use                                             | Jan      | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                                    | Nov     | Dec      |              |
|                                                                 | 63.4137  | 61.6744 | 59.7754 | 57.4116 | 55.3029 | 53.1114 | 52.6559 | 54.5510 | 56.4948 | 58.7453                                | 61.1301 | 63.3247  | (44)         |
| Energy content (annual)                                         | 100.4319 | 87.8236 | 91.8726 | 78.5936 | 74.4483 | 65.3067 | 63.6827 | 67.5456 | 69.6637 | 79.7168                                | 87.0910 | 99.1512  | (45)         |
| Distribution loss (46)m = 0.15 x (45)m                          |          |         |         |         |         |         |         |         |         | Total = Sum(45)m =                     |         | 965.3276 |              |
|                                                                 | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (46)         |
| Water storage loss:                                             |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
| Total storage loss                                              |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (56)         |
| If cylinder contains dedicated solar storage                    |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (57)         |
| Primary loss                                                    | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (59)         |
| Combi loss                                                      | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (61)         |
| Total heat required for water heating calculated for each month |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 85.3671  | 74.6500 | 78.0917 | 66.8045 | 63.2811 | 55.5107 | 54.1303 | 57.4137 | 59.2142 | 67.7593                                | 74.0273 | 84.2785  | (62)         |
| WWHRS                                                           | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (63a)        |
| PV diverter                                                     | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (63b)        |
| Solar input                                                     | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (63c)        |
| FGHRS                                                           | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000   | (63d)        |
| Output from w/h                                                 | 85.3671  | 74.6500 | 78.0917 | 66.8045 | 63.2811 | 55.5107 | 54.1303 | 57.4137 | 59.2142 | 67.7593                                | 74.0273 | 84.2785  | (64)         |
| 12Total per year (kWh/year)                                     |          |         |         |         |         |         |         |         |         | Total per year (kWh/year) = Sum(64)m = |         | 820.5284 | (64)         |
| Electric shower(s)                                              | 48.8226  | 43.5013 | 47.5018 | 45.3304 | 46.1810 | 44.0522 | 45.5206 | 46.1810 | 45.3304 | 47.5018                                | 46.6086 | 48.8226  | (64a)        |
|                                                                 |          |         |         |         |         |         |         |         |         |                                        |         | 555.3542 | (64a)        |
| Heat gains from water heating, kWh/month                        |          |         |         |         |         |         |         |         |         |                                        |         |          |              |
|                                                                 | 33.5474  | 29.5378 | 31.3984 | 28.0337 | 27.3655 | 24.8907 | 24.9127 | 25.8987 | 26.1361 | 28.8153                                | 30.1590 | 33.2753  | (65)         |

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## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| (66)m                                                                               | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | 109.5776 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 96.9448  | 107.3317 | 96.9448  | 100.1763 | 96.9448  | 100.1763 | 96.9448  | 96.9448  | 100.1763 | 96.9448  | 100.1763 | 96.9448  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 192.1089 | 194.1024 | 189.0789 | 178.3844 | 164.8845 | 152.1965 | 143.7201 | 141.7267 | 146.7502 | 157.4447 | 170.9446 | 183.6326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | 33.9578  | (69) |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | -87.6621 | (71) |
| Water heating gains (Table 5)                                                       | 45.0906  | 43.9551  | 42.2021  | 38.9357  | 36.7816  | 34.5704  | 33.4848  | 34.8101  | 36.3002  | 38.7302  | 41.8875  | 44.7248  | (72) |
| Total internal gains                                                                | 390.0176 | 401.2625 | 384.0990 | 373.3696 | 354.4841 | 342.8165 | 330.0230 | 329.3548 | 339.0999 | 348.9929 | 368.8816 | 381.1754 | (73) |

## 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |      | Gains<br>W   |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|------|--------------|
| North       |          |          |          |          | 4.9500     | 10.6334                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |      | 16.0860 (74) |
| East        |          |          |          |          | 9.9000     | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |      | 59.4230 (76) |
|             |          |          |          |          |            |                                |                                   |                                    |          |          |                              |          |      |              |
| Solar gains | 75.5090  | 146.9852 | 243.6740 | 363.1055 | 455.1985   | 471.2723                       | 446.4424                          | 376.0752                           | 285.4550 | 174.5266 | 93.9376                      |          |      | 62.2767 (83) |
| Total gains | 465.5266 | 548.2477 | 627.7731 | 736.4752 | 809.6827   | 814.0888                       | 776.4655                          | 705.4300                           | 624.5549 | 523.5196 | 462.8192                     | 443.4521 | (84) |              |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                     |         |         |         |         |      |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------|---------|---------|---------|---------|------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                     |         |         |         | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                 | Oct     | Nov     | Dec     |         |      |
| tau                                                                         | 15.3810 | 15.4077 | 15.4339 | 15.5581 | 15.5816 | 15.6918 | 15.6918 | 15.7123 | 15.6491             | 15.5816 | 15.5342 | 15.4849 |         |      |
| alpha                                                                       | 2.0254  | 2.0272  | 2.0289  | 2.0372  | 2.0388  | 2.0461  | 2.0461  | 2.0475  | 2.0433              | 2.0388  | 2.0356  | 2.0323  |         |      |
| util living area                                                            | 0.9245  | 0.8960  | 0.8510  | 0.7646  | 0.6506  | 0.5157  | 0.4050  | 0.4508  | 0.6362              | 0.8153  | 0.8991  | 0.9307  | (86)    |      |
| MIT                                                                         | 17.5440 | 17.9494 | 18.5899 | 19.4357 | 20.1426 | 20.6303 | 20.8402 | 20.7953 | 20.3951             | 19.4512 | 18.3602 | 17.4719 | (87)    |      |
| Th 2                                                                        | 19.8999 | 19.9015 | 19.9032 | 19.9110 | 19.9124 | 19.9192 | 19.9192 | 19.9205 | 19.9166             | 19.9124 | 19.9095 | 19.9064 | (88)    |      |
| util rest of house                                                          | 0.9156  | 0.8841  | 0.8336  | 0.7367  | 0.6075  | 0.4519  | 0.3208  | 0.3652  | 0.5763              | 0.7866  | 0.8855  | 0.9226  | (89)    |      |
| MIT 2                                                                       | 16.7591 | 17.1567 | 17.7821 | 18.5968 | 19.2524 | 19.6810 | 19.8419 | 19.8158 | 19.4977             | 18.6332 | 17.5725 | 16.6923 | (90)    |      |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / | (4) =   |         | 0.4705  | (91)    |      |
| MIT                                                                         | 17.1284 | 17.5297 | 18.1622 | 18.9915 | 19.6712 | 20.1277 | 20.3116 | 20.2767 | 19.9199             | 19.0181 | 17.9431 | 17.0591 | (92)    |      |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                     |         |         | 0.0000  |         |      |
| adjusted MIT                                                                | 17.1284 | 17.5297 | 18.1622 | 18.9915 | 19.6712 | 20.1277 | 20.3116 | 20.2767 | 19.9199             | 19.0181 | 17.9431 | 17.0591 | (93)    |      |

## 8. Space heating requirement

|                                                                                | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec       |       |
|--------------------------------------------------------------------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|-----------|-------|
| Utilisation                                                                    | 0.8854    | 0.8507    | 0.7995   | 0.7094   | 0.5970   | 0.4649   | 0.3527   | 0.3949   | 0.5765   | 0.7581        | 0.8534   | 0.8936    | (94)  |
| Useful gains                                                                   | 412.1855  | 466.3675  | 501.9143 | 522.4920 | 483.4092 | 378.4575 | 273.8464 | 278.5829 | 360.0658 | 396.9062      | 394.9869 | 396.2722  | (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000       | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W                                                               | 1065.6731 | 1047.3481 | 965.4770 | 828.7734 | 653.6591 | 450.0972 | 302.2226 | 315.2483 | 475.1842 | 690.2996      | 891.8724 | 1061.0559 | (97)  |
| Space heating kWh                                                              | 486.1948  | 390.4190  | 344.8907 | 220.5226 | 126.6659 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 218.2847      | 357.7575 | 494.5991  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |          |          |          |          |          |          |          |               |          | 2639.3342 |       |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000    | (98b) |
| Solar heating contribution - total per year (kWh/year)                         |           |           |          |          |          |          |          |          |          |               |          | 0.0000    |       |
| Space heating kWh                                                              | 486.1948  | 390.4190  | 344.8907 | 220.5226 | 126.6659 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 218.2847      | 357.7575 | 494.5991  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |          |          |          |          |          |          |          |               |          | 2639.3342 |       |
| Space heating per m <sup>2</sup>                                               |           |           |          |          |          |          |          |          |          | (98c) / (4) = |          | 38.9282   | (99)  |

## 8c. Space cooling requirement

|                                                     |        |        |        |        |         |          |          |          |                    |         |        |          |       |
|-----------------------------------------------------|--------|--------|--------|--------|---------|----------|----------|----------|--------------------|---------|--------|----------|-------|
| Calculated for June, July and August. See Table 10b | Jan    | Feb    | Mar    | Apr    | May     | Jun      | Jul      | Aug      | Sep                | Oct     | Nov    | Dec      |       |
| Ext. temp.                                          | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000  | 16.6000  | 16.4000  | 14.1000            | 10.6000 | 7.1000 | 4.2000   |       |
| Heat loss rate W                                    | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 765.4073 | 602.5546 | 618.0295 | 0.0000             | 0.0000  | 0.0000 | 0.0000   | (100) |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7296   | 0.7857   | 0.7508   | 0.0000             | 0.0000  | 0.0000 | 0.0000   | (101) |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 558.4178 | 473.4115 | 463.9947 | 0.0000             | 0.0000  | 0.0000 | 0.0000   | (102) |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 915.2213 | 873.1457 | 791.9963 | 0.0000             | 0.0000  | 0.0000 | 0.0000   | (103) |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 256.8985 | 297.4022 | 244.0332 | 0.0000             | 0.0000  | 0.0000 | 0.0000   | (104) |
| Cooled fraction                                     |        |        |        |        |         |          |          |          | fC = cooled area / | (4) =   |        | 1.0000   | (105) |
| Intermittency factor (Table 10b)                    | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500  | 0.2500   | 0.2500   | 0.2500   | 0.2500             | 0.2500  | 0.2500 | 0.2500   | (106) |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 64.2246  | 74.3506  | 61.0083  | 0.0000             | 0.0000  | 0.0000 | 0.0000   | (107) |
| Space cooling requirement                           |        |        |        |        |         |          |          |          |                    |         |        | 199.5835 | (107) |
| Energy for space heating                            |        |        |        |        |         |          |          |          |                    |         |        | 38.9282  | (99)  |
| Energy for space cooling                            |        |        |        |        |         |          |          |          |                    |         |        | 2.9437   | (108) |
| Total                                               |        |        |        |        |         |          |          |          |                    |         |        | 41.8719  | (109) |
| Fabric Energy Efficiency (TFEE)                     |        |        |        |        |         |          |          |          |                    |         |        | 41.9     | (109) |